Chang Oh is working to develop the next generation nuclear reactor—a safer, greener reactor that produces zero carbon dioxide gas emissions to the environment.

Safer, greener reactor design is Oh's goal

By Cathy Koon for *INL Nuclear Science and Technology Communications*

Nuclear reactors of the future are being designed today, and thanks to Idaho National Laboratory engineers like Chang Oh, they will be safer and greener.

Oh has been working for nearly four decades to develop the next generation nuclear reactor to be safer and produce zero carbon dioxide gas emissions to the environment. He has worked at INL for 29 of those 40 years.

Chang Oh was honored recently with the INL's Exceptional Engineering Achievement Award.

Oh is considered a world leader in developing and applying new concepts to nuclear systems. Currently, he is investigating air ingress phenomena and tritium permeation for high temperature gas-cooled reactors, research that has significantly advanced knowledge for future nuclear reactor designs.

As a thermal hydraulics analyst, he has worked on nuclear reactor safety, heat transfer and computational flow field of nuclear reactor safety. Specific project areas have included the following: development of critical heat flux correlations in thin flow channels under low pressure and low mass flow, which mimic the natural convection for the Advanced Test Reactor (ATR) at INL; flow instability; flow and chemical reaction modeling of supercritical water oxidation; and thermal hydraulics analysis of very high temperature gas-cooled reactors (VHTRs).

His VHTR thermal hydraulics research is part of Next Generation Nuclear Plant Research and Development method development and engineering, the Department of Energy's Nuclear Engineering Research Initiative (NERI) and International NERI. He was instrumental in performing the system integration of the VHTR and the hydrogen production process of high temperature steam electrolysis (HTSE).

Based on his work on power conversion and its optimization, he was able to develop an innovative idea that reduces the VHTR operating temperature from 900 to 700 degrees C with only a 2 percent reduction in the overall plant efficiency, compared to the baseline efficiency of 46 percent. This invention achieves 44 percent efficiency at 700 degrees C VHTR outlet temperature in an indirect cycle by combining the use of (1) recycled hydrogen to preheat the HTSE inlet stream, (2) a combination of working fluids in the primary, secondary and tertiary flow loop, and (3) a unique power conversion cycle. These are the core elements of the invention.

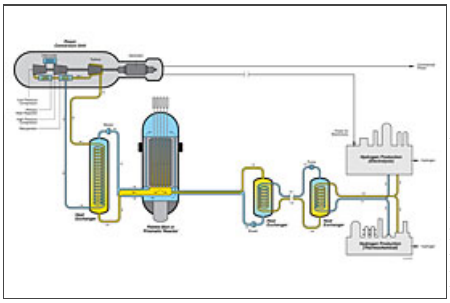
If implemented, Oh's breakthrough invention will resolve material problems resulting from corrosion and creep caused by the proposed 900 degrees C VHTR outlet temperature by mitigating significant material problems in the NGNP. The concept would save considerable investment in research and development.

"I strongly believe that the VHTR has many advantages in terms of fuel integrity, proliferation resistance, reactor safety and modularity," Oh said.

In addition, it can be "coupled with many industry process applications for the oil and chemical industry due to its high temperature," he said. "I hope that my research involvement in computational fluid dynamics calculations and the code validation for understanding the hypothetical accident scenarios ultimately helps the nuclear reactor designer and nuclear industry."

Oh and his team also developed the Computational Fluid Dynamics (CFD) model that illustrates a scenario named density-gradient-driven stratified flow. This scenario is considerably different from the previously common one that modeled air movement into the reactor vessel and then to the core region via diffusion.

He was honored recently at the 15th Annual Idaho National Laboratory Honors Banquet with the INL's Exceptional Engineering Achievement Award, which recognizes an individual who is internationally known for turning ideas into products.



Chang Oh developed an innovative approach for reducing the VHTR operating temperature from 900 to 700 degrees C.

"I was thrilled, and I wanted to share the recognition with other engineers who have worked with me in the past," Oh said about his reaction to receiving the honor.

Oh enjoys his work at INL and the people he works with. He considers his biggest challenge over the next few years to be maintaining stable funding and quality work.

Before coming to INL, Oh worked with Ethyl Corporation in Baton Rouge, La., where he was responsible for computer simulation for revamping four distillation column "loops" in Ethyl's hydrocarbon plant. He looked at process evaluation, optimization for energy conservation, heterogeneous catalytic deactivation kinetics study, chemical reactor analysis, process model development and validation, computer simulation, and economic evaluation.

Oh earned his Ph.D. from Washington State University, his master's degree from the University of Florida, and his bachelor's degree from Yonsei University, Korea. All his degrees are in chemical engineering.

Oh has written one book as editor-in-chief and more than 100 peer-reviewed archival journal and conference papers on nuclear safety, thermal hydraulics, CFD modeling and computer code development. He served as the division chair of the Thermal Hydraulics Division of the American Nuclear Society, and as division chair of the Heat Transfer Division of the American Society of Mechanical Engineers (ASME). He was named ASME Fellow in 2001. He served as associate editor of the Journal of Heat Transfer where he is responsible for reviewing journal papers submitted in the boiling two-phase field.

Since 2003, Oh has successfully brought a number of DOE projects through peer review competitions as part of DOE's NERI program. He has been rated at the top 10 percent in the NERI program, competing against other awarded principal investigators.

Outside of work, Oh enjoys most sports, including hiking, skiing, golf, tennis and volleyball.

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